REMARKS

This response is submitted in response to the Final Office Action dated September 10, 2003, and respectfully requests that the Examiner reconsider the rejection of the claims as set forth therein. In the event that the Examiner determines that the foregoing Amendment does not place the application in condition for allowance, it is respectfully requested that the foregoing Amendment be entered to place the claims in better form for consideration upon appeal.

Allowable Subject Matter: Claims 24-27

As noted in the previous Office Action of March 25, 2003, the Examiner has allowed claims 24-27.

At the outset, prior to addressing the rejections over the prior art, the applicants call to the Examiner's attention that claim 1 has been amended to correct an obvious error regarding the recitation of -- switching elements connected to said signal lines that individually control electric fields applied to said pixel electrodes of said pixels,--. The underlined portion was inadvertently omitted in the response entered on June 19, 2003 due to a typographical error. No reference was made to intentionally deleting this limitation. This limitation did appear in its entirety in the Response After Final Rejection of January 27, 2003 entered by continued prosecution application (CPA) filed on February 20, 2003. Therefore, no new matter has been entered.

35 U.S.C. 103(a) Rejections: Claims 1-2, 5-6, 9, 12, 15-16, 19-20 and 23

The Examiner continues to reject claims 1-2, 5-6, 9, 12, 15-16, 19-20 and 23 under 35 U.S.C. 103(a) as being unpatentable over Ohta et al. (US 6,064,460 – filed May 15, 1998 – issued May 16, 2000) in view of Numano et al (US 6,313,898 B1 – filed December 15, 1998 – issued November 6, 2001).

Claims 1, 5, 15, 19 and 23

In the applicants' response filed on June 19, 2003 to the Office Action of March 25, 2003, the applicants had amended claim 1 to enhance the definition of the pixel aperture region as follows: "said pixels including apertures, said apertures and a part of said pixel electrodes defining pixel aperture regions".

The applicants argued that therefore, the orientation of the alignment direction of the second alignment layer at the signal line regions differs from the alignment direction of the second alignment layer *at the pixel aperture regions, which include only a part of the pixel electrode and not the entire pixel electrode as is the case in Numano et al.*

The applicants noted that in Numano et al, FIG. 7, the direction of orientation of the liquid crystal molecules is changed at the signal wiring regions 7 as compared to the direction of orientation at the adjacent pixel electrodes 12 and 12a (shown in FIG. 11(a) of Numano et al). In Numano et al, FIG. 7, there is no pixel aperture region which includes the pixel aperture and a part of the pixel electrodes, as recited by claim 1. The pixel electrodes 12 and 12a each occupy the entire respective pixel aperture.

The applicants respectfully maintained that the Examiner had not fully considered the applicants arguments in favor of claim 1, in that the orientation of the alignment direction of the second alignment layer at the signal line regions differs from the alignment direction of the second alignment layer *at the pixel aperture regions, which include only a part of the pixel electrode and not the entire pixel electrode as is the case in Numano et al.*

The applicants again concluded that neither Ohta et al, nor Numano et al, taken alone or in combination, disclose, teach or suggest alignment direction of said second alignment layer at said signal line regions differing from alignment direction of said second alignment layer at said pixel aperture regions, nor pixel aperture regions which include only a part of the pixel electrode, as recited by claim 1.

In the current Final Rejection, the Examiner continues to assert that Ohta et al disclose all of the limitations of claims 1, 5, 15, 19, and 23, except that Ohta et al do not disclose that the alignment process is carried out such that the alignment layer of a pixel aperture region is different from a signal line region.

The Examiner continues to assert that Numano et al in FIG. 7 disclose that alignment of alignment layers differs at regions (19a) of signal lines (7) and their vicinities (e.g., pixel aperture region).

The Examiner continues to maintain that it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Ohta et al having an alignment layer in which liquid crystal molecules at a pixel region

are aligned differently from liquid crystal molecules at a signal line region, as recited by claim 1.

In the Response to Arguments section, the Examiner states his position that the Examiner had respectfully invited the applicants to review the Ohta et al reference (FIG. 2) in which Ohta et al do disclose a pixel region (aperture pixel and a part of pixel electrode) and a signal line region (signal lines and adjacent regions, namely black matrix regions) as claimed. The Examiner continues by asserting that the applicants' alignment which covers pixel aperture regions (e.g. regions 55) and the other part of the pixel electrode (e.g., regions 55A and 55B), according to FIGS. 10-11 and 15 (region 52), would have the same alignment direction which is different from alignment direction of that alignment layer at said signal line regions (regions 54A and 54B), as is the case in Numano et al. The Examiner continues by asserting that in other words, although Numano et al. do not disclose "pixel aperture regions" which include only a part of the pixel electrode, the Applicants' pixel aperture region and the Numano et al. pixel aperture region would be the same as well, even though that is a part or entire pixel electrode. The Examiner continues by asserting that, therefore, the modification to Ohta et al. by Numano et al. would form an alignment direction of a second alignment at the signal line regions differing from alignment direction layer at the pixel aperture regions and such modification would have been obvious to one skilled in the art to obtain an LCD device which is high in aperture ratio and is free from cross talk (Numano et al. abstract).

In response, the applicants wish to call to the Examiner's attention that Ohta et al, Abstract, discloses the following: "...The twisting extent of the liquid crystal molecules is controlled by an electric field which is generated between the pixel electrode and the counter electrode and which has a component substantially parallel to said first substrate..."

Although Ohta et al do not specifically disclose the terminology of a horizontal-field-drive type display of in-plane switching LCD, the applicants maintain that the Abstract illustrates that the invention of Ohta et al is a horizontal-field-drive IPS LCD.

The applicants also maintain that the invention of Numano et al is a vertical-field-drive type TN-LCD. This position is supported by column 3, lines 54-57 of Numano et al which discloses that "The present invention relates to a liquid crystal displaying apparatus where in the adjacent pixel electrodes, the lateral electric field from the adjacent pixel electrode is lowered by making the longitudinal electric field stronger in the pixel electrode end on the side where the disclination is caused."

Since it is the longitudinal electric field which predominately causes the disinclination, the applicants maintain that since the invention of Numano et al is a TN liquid crystal display, the invention of Numano et al of a vertical-field-drive type display fundamentally differs from the present invention.

As a result, the applicants maintain that since the Examiner concedes that Numano et al do not disclose "pixel aperture regions" which include only a part of the pixel electrode and since the invention of Numano et al is a vertical-field-drive type TN-LCD, the Examiner's conclusion that the Applicants' pixel aperture region and the Numano et al pixel aperture region would be the same as well, even though that is a part or entire pixel electrode, is incorrect.

Specifically, there is a difference between the method for driving liquid crystal molecules of a TN mode liquid crystal and of an IPS mode liquid crystal, and furthermore, there are differences between the two types of liquid crystals in the shape and arrangement of electrodes and materials to be utilized. Therefore, there would be no motivation to combine the teachings of Ohta et al. and the teachings of Numano et al. unless the techniques are applicable to each other or the techniques are common to any liquid crystal display apparatus.

In addition, the applicants respectfully call to the Examiner's attention that the present invention is directed to an IPS (In-Plane Switching) mode liquid crystal display, and the object of the invention is to solve the problems as set forth on page 7 lines 7 to 21 of the specification. In the specification there are mentioned two prior art methods for the solution to the problems (page 9, lines 13 to 20), and the object of the present invention is to provide an IPS (In-Plane Switching) mode liquid crystal display for solving the problems without reduction of the aperture ratio and increase of parasitic capacitance between the common electrodes and the drain lines, which would result from the two prior art methods.

In order to achieve the object, claim 1 defines "signal lines and adjacent regions defining signal line regions, and apertures and a part of pixel electrodes defining pixel aperture regions" and recites that alignment direction of the first alignment layer at the signal line regions differs from alignment direction at the pixel aperture region.

The disclosures in the reference Ohta et al. (USP 6064460) relates to an IPS liquid crystal display apparatus, and there is disclosed that the pixel electrode PX and the counter electrode CT are opposed to each other on the same substrate SUB 1, and the optical state of the liquid crystals CT is controlled by lateral electric field generated between each pixel electrode and the counter electrode, thereby to control the display (see col. 13, lines 16 to 30, FIGS. 1A to 1D, FIG. 2).

Numano et al. (USP 6313898) relates to a TN mode liquid crystal display apparatus in which the periphery of the pixel electrodes are overlapped with the signal wiring and the pixel electrodes are positioned adjacent to each other on the signal wiring, an intermediate alignment film is formed between the adjacent pixel electrodes 12, 12a, the intermediate alignment film being in alignment different from the alignment film 13 on the pixel electrodes, thereby to reduce the cross talk between the adjacent pixel electrodes (refer to col. 7, lines 26 and 27, lines 39 to 42, col. 8, line 64 to col. 9, line 9, FIGS. 1, 2, 5(b)).

In other words, as the distance between the adjacent pixel electrodes becomes narrower, the liquid crystal molecules of the pixel end portions are affected by the lateral electric field from the adjacent pixel electrodes (col. 2, lines

16 to 20), and therefore the cross talk problem in the TN liquid crystal display apparatus can be solved by forming the intermediate alignment film.

As noted, the Examiner asserts that although Ohta et al. do not disclose the alignment process is carried out such that the alignment layer of a pixel aperture region is different from a signal line region, Numano et al. do disclose that alignment of alignment layers at regions (19a) of signal lines (7) and their vicinities (e.g. pixel aperture region) (see FIG. 7). The Examiner asserts that therefore, it would have been obvious to one skilled person in the art at the time the invention was made to modify the Ohta et al. device having an alignment layer in which crystal molecules at a pixel region are aligned differently from those at signal lines as shown by Numano et al. in order to obtain an LCD device which is high in aperture ratio and is free from the cross talk (see abstract).

On the contrary, the applicants maintain that the reference, Numano et al. does not disclose that the alignment of the signal line (7) differs from that of their vicinities, as the Examiner maintains. If reference is made to FIG. 7 which is cited by the Examiner, it can be seen that the periphery of the adjacent pixel electrodes 12, 12a is overlapped with signal line 7, and located adjacent to each other on the signal line 7. FIG. 7 shows a cross section of embodiment 2 which is similar to that of embodiment 1 (FIG. 1 is the cross section taken along line D-E of FIG. 2), and differs from embodiment 1 only in structure and function of intermediate alignment layer 13a. With reference to FIG. 2, which is the plan view of embodiment 1, it clearly shows that the periphery of the adjacent pixel electrodes 12, 12a is overlapped with signal line 7, and located adjacent to each other on the signal line

7. Such a structure should be expected to result, taking into consideration that the reference, Numano et al., is directed to a liquid crystal display having such a structure.

Since Numano et al. disclose that intermediate alignment film 13a is formed between the adjacent pixel electrodes 12, 12a with the alignment differing from that of alignment film 13 over the pixel electrode, only a part, located between the adjacent pixel electrodes 12, 1 2a, of the alignment film positioned over signal line 7 shown in FIG. 1, is intermediate film 13a.

In other words, the Numano et al. reference shows that only a part of the signal line 7 has alignment differing from that of the other regions, and the Numano et al reference does not show that the signal line region defined by the signal line and its adjacent region has an alignment direction different from the alignment direction at the pixel region, as in the present invention recited by claim 1.

As stated above, claim 1 recites that the signal line regions are defined by the signal lines and the adjacent regions and the pixel aperture regions are defined by apertures and a part of the pixel electrodes, and the alignment direction of the first alignment layer at the signal line region differs from the alignment direction at the pixel aperture region. However the reference, Numano et al., does not disclose such a structure.

The reference, Numano et al., discloses only a TN mode liquid crystal display apparatus, and it discusses the problems to be solved in the TN mode liquid crystal display apparatus, the solutions to the problems, and the effect of the

invention throughout the specification. Thus, there is neither a teaching nor disclosure of the IPS mode liquid crystal display apparatus as in the present invention, nor recognition of the problems to be solved by the present invention. Therefore one of ordinary skill in the art at the time the invention was made would not be motivated to combine the TN mode liquid crystal display of Numano et al. with the IPS mode liquid crystal display apparatus of Ohta et al.

Even if one of ordinary skill in the art at the time the invention was made were somehow motivated to combine the IPS mode liquid crystal display of Ohta et al with the TN liquid crystal display of Numano et al, taking notice that Numano at al. reference discloses that the alignment film located between the adjacent pixel electrodes has an alignment direction different from the alignment film positioned on the pixel electrodes, the result would be a liquid crystal display apparatus where, as disclosed in Numano et al., the alignment film located between the adjacent pixel electrodes has alignment different from that of the alignment film positioned on the pixel electrodes for the IPS mode liquid crystal display apparatus of Ohta et al. reference.

However, in the hypothetical liquid crystal display apparatus obtained from such a combination, it is difficult to drive liquid crystal molecules immediately over the pixel electrodes, since the lateral electric field is weak in the structure of an IPS mode liquid crystal display apparatus in which the liquid molecules are driven by generating the lateral electric field between the pixel electrodes, and to drive the liquid crystal molecules in the regions over the portions between the pixel electrodes where the liquid crystal molecules are processed to have alignment

different from the alignment of the liquid crystal molecules over the pixel electrodes.

Therefore, the hypothetical liquid crystal display apparatus obtained from such a combination would not solve the problems such as vertical cross talk and stepping non-uniformity, as the present invention of claim 1 can solve, without reduction of the aperture ratio or an increase of parasitic capacitance between the common electrodes and the drain lines.

This is supported by the fact that a TN mode liquid crystal display apparatus and an IPS mode liquid crystal display apparatus are different from each other in the shape of pixel electrodes according to their operational modes.

More specifically, there is a difference in that in the TN mode liquid crystal display the pixel electrodes of broad area are positioned in the display area surrounded with adjacent scanning lines and adjacent signal lines, whereas in the IPS mode liquid crystal display apparatus where liquid crystal molecules are driven by the lateral electric field generated between the pixel electrodes and the common electrodes so as to twist on a plane, the narrow comb-teeth shaped pixel electrodes are positioned in the display area surrounded with adjacent scanning lines and adjacent signal lines (Ohta et al., col. 13, lines 19 to 20, describes "The pixel electrodes PX and counter electrodes CT are formed like comb teeth, and extend in a slender form in the up-and-down direction."). A person of ordinary skill in the art at the time the invention was made would not think of a combination of such different liquid crystal display techniques.

In summary, neither Ohta et al, nor Numano et al, taken alone or in combination, disclose, teach or suggest alignment direction of said second alignment layer at said signal line regions differing from alignment direction of said second alignment layer at said pixel aperture regions, nor pixel aperture regions which include only a part of the pixel electrode, as recited by claim 1.

Even if one or ordinary skill in the art were to somehow combine the in-plane switching device of Ohta et al. with the alignment layers of Numano et al. the hypothetical device resulting from such a combination would not yield the present invention of claim 1.

Therefore, claims 1, 5, 15, 19 and 23 patentably distinguish over the prior art. As a result, the applicants respectfully request the Examiner to withdraw the rejections of claims 1, 5, 15, 19 and 23.

35 U.S.C. 103(a) Rejections: Claims 2, 6, 9, 12, 16 and 20

The Examiner has again rejected claims 2, 6, 9, 12, 16 and 20 as being unpatentable over Ohta et al. in view of knowledge notoriously well known in the art to reduce a driving voltage in a LCD device by using liquid crystal molecules having a positive dielectric constant anisotropy.

The Examiner asserts that the combination of Ohta et al. and Numano et al does show the alignment layer process occurring in the signal line regions and the pixel aperture regions. The Examiner asserts further that such claims would have been obvious in view of the notoriously well known knowledge in the LCD art.

In response, the applicants maintain that, since all of the claims in question depend from claim 1 directly or indirectly, neither Ohta et al. nor the notoriously well known knowledge cited by the Examiner overcomes the deficiencies of Numano et al with respect to claim 1 and therefore, claims 2, 6, 9, 12, 16 and 20 patentably distinguish over Ohta el in view of Numano et al and further in view of the notoriously well known knowledge cited by the Examiner.

Therefore, the applicants request that the Examiner withdraw the rejection of claims 2, 6, 9, 12, 16 and 20.

Reconsideration of this application and entry of the foregoing amendment in view of the foregoing remarks is respectfully requested. The foregoing remarks establish the patentable nature of all of the elected claims in the application, i.e., generic claim 1 and elected claims 2, 5-6, 9, 12, 15-16, 20 and 23. Claim 24-27 are allowed. No new matter has been added, and no new issues have been raised, wherefore early and favorable reconsideration and issuance of a Notice of Allowance are respectfully requested.

Respectfully submitted,

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